Texas Highways

April, 1962

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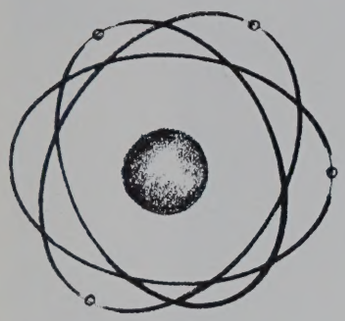
Editorial

A significant tribute to the Texas Highway Department is found in the latest annual inventory of traffic safety activities compiled by the Texas Traffic Safety Council. It is appropriate to throw light on the item at this time, since the entire State's attention has been focused on the subject of highway safety by the annual Texas Safety Conference held in Dallas in late March.

A brief portion of the Safety Council's inventory report summed up in a few words the outstanding results of the work of thousands of Highway Department personnel:

> "Traffic and Highway Engineering, rated at 91 per cent, continued outstanding—the strongest phase of the Texas accident prevention program."

The inventory revealed that engineering outranked all other highway safety activities, remaining the strongest "E" in the three "E's" of highway safety—Engineering, Education, and Enforcement.



NUCLEAR

DENSITY-MOISTURE GAUGE

Early in 1960, highway engineers in San Antonio, District 15, saw a need for faster and better methods to determine density and moisture in highway construction projects. They felt that with the trend toward end-result specifications, the present density and moisture control methods were fast becoming inadequate. Conventional methods were subject to human error and often caused costly and needless delays during construction because of the time-consuming procedures involved.

With the help of Research Engineer M. D. Shelby, Highway Design in Austin, and the Department Research Committee, a request was approved for the purchase of a nuclear device for determining densities and moistures. The nuclear instruments were received in April 1961 and District 15 became pioneers in the nuclear-testing method.

Under the supervision of District Laboratory Engineer Charles Baxter, Henry Hardy, Materials Analyst III, began testing and experimenting with the new instrument to determine its capabilities. It took many hours of work and study to correlate the new instrument with conventional methods. Hardy patiently carried out exhaustive tests—from boxes of soil, concrete slabs, asphaltic concrete, base materials, to subgrade soils—everything the Department might encounter on a job. He plotted scores on the tests to compare the nuclear method with conventional tests. Results indicated effective depth measurement of the gauge to be about six inches.

One of the basic differences between the two methods is that the conventional method is a destructive test where a core sample has to be taken and the nuclear method does not disturb the soil or concrete. Hardy based all his procedures on a lab report from the Colorado Highway Department.

The new instrument was tested on a number of highway projects, but always in conjunction with conventional methods as a double check. As early as July 1961 Baxter felt enough groundwork had been done to prove the accuracy of the instrument. He urged a request be made to Austin and the Bureau of Public Roads for recognition to use the instrument on highway projects. At the Laboratory Engineers Conference in Lubbock the Bureau of Public Roads accepted use of the nuclear method but requested an occasional check be made by conventional methods.

Although the nuclear density-moisture gauge is still in the experimental stages in the district, the device has been used exclusively on five bridge approaches and on twelve other jobs where conventional tests were employed as a check. Testing during the past year has been performed on crushed limestone, caliche gravels, clays, sand clays, lime-treated clays, lime-treated sand clays, concrete, and asphaltic concrete.

Frank Wehrman, Engineering Aide II, takes a one-minute density reading with District 15's nuclear gauge . . .

. . . while Bernard King, Materials Analyst III, performs the standard volumeter test for determining density.

The nuclear density-moisture gauge used in District 15 is completely portable. Frank Wehrman, Engineering Aide II, checks the scaler and density probe before taking the instrument out to the job site. The rectangular density probe (right foreground) contains a small pellet of Cesium-137.

Senior Laboratory Engineer Charles Baxter (left), District 15 in San Antonio, and Henry Hardy, Materials Analyst III, transcribe nuclear density "counts" to pounds per cubic foot with the aid of a calibration curve.

Baxter is convinced the new method can do the work required on any construction job the Department may encounter. Although there is some difficulty at this time in correlating subgrade soil tests with the volumeter method, he believes the nuclear gauge is reading "what is actually there."

The gauge that has District 15 personnel singing its praises is completely portable and contains only three major parts—a scaler, a density probe, and a moisture probe. The battery-powered scaler has five glow-tube counters that can accumulate up to 99,999 counts. To read the density or moisture content of the material being tested, the operator takes a one-minute reading and then reads a calibration curve that changes "counts" into pounds per cubic foot or per cent moisture.

The moisture probe contains a five-millicurie pellet of radium beryllium with a half life of 1,620 years. The density probe contains a three-millicurie source of Cesium-137 with a half life of 30 years. Each probe is constructed so that when it is lifted a lead shield closes around the radioactive material. As a check for exposure to radiation, operators are required by the Atomic Energy Commission to wear film badges. The badges are checked periodically by Nuclear-Chicago — manufacturers of the gauge. There has been no trace of radiation thus far.

A one-minute reading on the scaler is all that is required to determine moisture content. Density-gauge readings take at least two minutes because the probe must be rotated 90 degrees after the first reading, another taken, and the results averaged for the final answer. Hardy, working by himself, has made as many as fifteen tests in 150 minutes. By the conventional method, it usually takes two men one day to complete the same amount of work.

Senior Resident Engineer Charles E. Hackebeil of Hondo likes the speed with which the nuclear instrument

can aid in laying base courses.

"It really helps to put down the base material faster," Hackebeil said, "because the contractor doesn't have to wait several hours for the lab test results before he rolls the next course. Now, right on the site, the contractor can be told whether or not the base needs more compaction or water, or that he can go ahead with the next course."

Sometimes unexpected readings occur that seem unreasonable, either too high or too low for generally known conditions. In testing soil density of the bridge approaches of the Salado Creek Bridge crossing on Loop 13 in San Antonio, Hardy obtained four readings that were too low for the compacted earth. He began to dig. The first two inches of soil were compacted as expected.

Then Hardy discovered a mixture he could "stir with a spoon."

"It just shows," Hardy said, "this gauge will read what's there."

Baxter said the conditions might have been discovered by the volumeter method, but with the new gauge Hardy was able to explore the extent of the loose earth in a short time—something that would have taken several hours by conventional means.

Film badges worn by the operators are gathered and mailed to Chicago every two weeks where they are tested for radiation. A new supply of badges is sent to the district lab every two weeks along with a written report. Once a year the instrument has to be checked by a representative of the company for "leaks." The gauge is kept in a locked closet clearly marked for radiation danger.

One of the AEC requirements is that only qualified personnel be allowed to operate the nuclear device. Baxter said a man can learn to use the instrument in one day, whereas the volumeter method takes longer to learn and readings vary according to the operator. Presently, the nuclear gauge has to be operated by or under the direct supervision of Baxter or Hardy; Bernard King, Materials Analyst III; or Frank Wehrman, Engineering Aide II.

Behind this locked door is the first nuclear density-moisture gauge to be tested and used by the Highway Department.

To speed up use of the density-moisture gauge in the field, the lab has requested a radio-equipped vehicle. This will allow the instrument to be moved from one job site to another without having to return to district headquarters for a new assignment.

A northern state recently inquired about the accuracy and advantages of the nuclear method of testing.

"It is a good, conservative, and proper method of handling field testing for densities and moistures in highway construction," Baxter wrote in answer to the query. "The time saved by being able to give contractors density results in a shorter length of time, thus minimizing delays in construction, should be reflected in future bid prices."

The unreflectorized white stripe, used to replace string line, is cheaper, faster, and easier to see.

Something new is being used in District 2 in the art of putting a string line down for an overlay. The concept of using a two-inch unreflectorized white stripe as a string line was used in the spring of 1961 to mark the edges of the pavement in laying an overlay.

String Line by Striping

James E. Kelly
Engineering Clerk II
District 2

This new method of striping has many advantages over the old string-line method. In our cost studies, we found that the string line costs more per mile to put down and maintain than does the stripe. In addition, the stripe is much easier to see by the blade man and can be seen through tack coat also. Using a stripe guide instead of a string line prevents any chances of the string line breaking or slackening. Two or three men are required to maintain the string line after it is placed; the two-inch stripe

The stripe is used to lay straight edges, as above.

Easily seen through the tack coat, the stripe requires no maintenance.

String lines sometimes broke, or got out of alignment through slackening. The stripe remains constant.

requires no maintenance.

The time element in placing this stripe is much quicker than laying the string line. In placing the stripe, the striping crew guides off of dots laid on the edge of the pavement. The striper can place the stripe at a speed of between 20 and 25 miles per hour, whereas laying a string line is a tedious, time-consuming task.

This stripe has been tried in two overlays, and the blade men were able to lay an overlay with more uniformity and straighter edges. Therefore, until this method is proven insufficient, we plan to continue using it in District 2 to mark the edges of the pavement for overlays.

Motor Vehicles are Their Business

. . . from Junior's motor scooter
to Dad's motorboat

Luke Patrenella
Travel and Information Division

The man's voice on the other end of the long-distance telephone call from Saskatchewan, Canada, sounded anxious. He had a chance to sell, at a profit, the automobile he bought in Texas.

But he needed a copy of his Certificate of Title.

Miss Kitty Needham, supervisor of the telephone receptionists in the Registration and Title Information Center of the Motor Vehicle Division, asked him for his license number. Conversation ceased for a few minutes while the man went outside to take down his license number.

In less time than it takes to type this sentence, Miss Needham had located the man's license receipt and noted the serial number thereon. With this information, she located his title record and advised him of the procedure to follow.

(Miss Needham also noted the automobile record was not "flagged" as a stolen vehicle.)

Such calls—in the state, out of state, and in this case, out of country—are routine in the operations of this information center. The women who work in it sit at adjoining desks and wear earphones to leave their hands free to take down information.

These telephone receptionists take pride in the split-second timing with which they can locate anyone's motor

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R. W. Townsley, Director of Motor Vehicle Division, adds the Disaster plate to an exhibit of 28 different Texas license plates at MVD's headquarters at Camp Hubbard.

vehicle registration and title record. All they need is either the license number, or a combination of the make and serial number of the motor vehicle.

(Incidentally, there are no name files in this section, and the copy showing the license number is the master copy.)

Given the necessary information, any one of the women—Miss Needham, Mrs. Lucille Chapman, and Mrs. Bobbie Davis, as well as alternates Mrs. Vallie Hibbs and Mrs. Lynn Killingsworth—can locate the requested records in less than a minute. Pare 30 seconds off a minute, and you're even closer to the average time it takes any one of them to locate the information in the comprehensive records housed in hundreds of steel file cabinets in Room 207 at Camp Hubbard.

"Comprehensive" in this instance includes a total of 45,000,000 various kinds of records kept on passenger cars, trucks, semi-trailers, trailers, as well as Junior's motor scooter—and his Dad's motorboat. That mammoth figure breaks down into some 13,000,000 Certificate of Title cards (7,500,000 active and 5,500,000 inactive) and 32,000,000 registration receipts. The latter figure represents license number files, serial number files, tax collector receipt files, and motorboat number files.

Mrs. Chapman, who has been wearing her earphones for more than a decade, said the receptionist's job has not given her cauliflower ears.

"But they certainly have grown since I got here," she laughed.

As for those fast trips from desk to files, and back to desk—trips that would dazzle a Texas Relays timekeeper, she comments:

"I tell you I wear out a lot of shoes this way."

Beverly Goff, in the old-model automobile, displays the two plates a driver affixed to his motor vehicle in 1917. That was the year motorists put a disc plate on the radiator and the longer plate on the rear of the vehicle. Vicky Stark in the sleek 1962 convertible shows off the more streamlined plate of today. Miss Goff is in the File Checking Section, and Miss Stark works in the Correspondence Section.

Law enforcement agencies and business firms recognize this information center for identification of motor vehicle licenses and titles as the only reliable source of such information in Texas.

Investigator Jim Sparks makes sure unexpired license plates off wrecked motor vehicles don't get a "free ride."

And individuals, once they have been served by this center, quickly become champions, too, of this 24-hour service that is available to anyone with just a paid (if long-distance) call to HOmestead 5-6553.

But this answering service is just one of the many operations in Motor Vehicle Division, largest of the seventeen divisions in the Texas Highway Department.

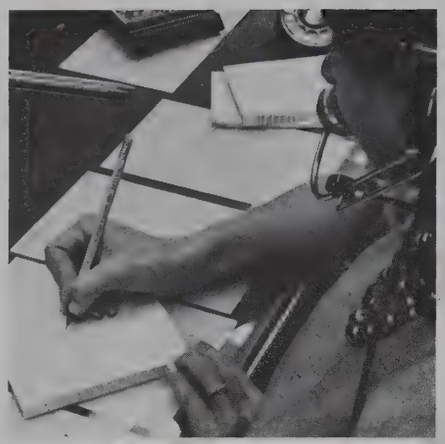
Specifically, the duties and responsibilities of the Motor Vehicle Division are these:

(1) Design and manufacture of motor vehicle license plates.

(2) Distribution of the plates to the tax collectors in the 254 counties of Texas.

(3) Issuance of the plates by the county tax collectors who act as designated agents of the Highway Department.

(4) Accounting for monies received from license-plate sales and proper distribution of fees to counties and the State of Texas.



Anyone dialing HOmestead 5-6553 gets the Registration and Title Information Center of the Motor Vehicle Division in Austin (center) where telephone receptionists like (left to right) Miss Carole Caldwell and Mrs. Lucille Chapman quickly supply information requested on motor vehicle registration and title records. . . .

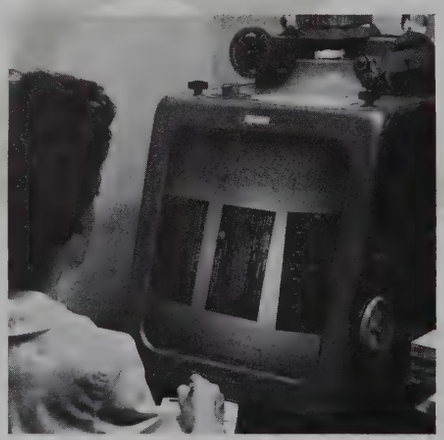
Mrs. Chapman (top left) takes down the pertinent information she'll need to locate the requested information. . . .

HO 5-6553

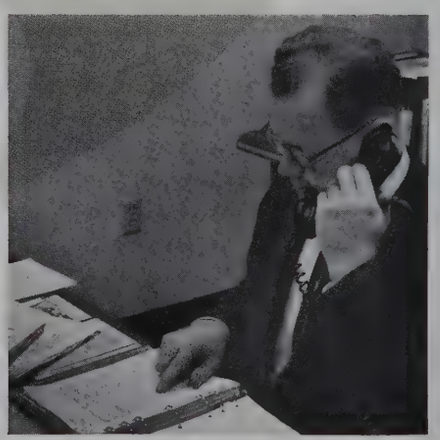
Among the comprehensive files retained in Room 207 of Camp Hubbard are photostatic copies of Certificates of Title like the ones being consulted in the top center picture. . . .

Passenger Car License Receipts (top right) also are on file in this room that could easily accommodate a 28-lane bowling alley. . . .

Sometimes, the calls to the Austin telephone number mean a check in the Microfilm Library where Mrs. Armelle Lewis (bottom left) checks some of the records retained on more than 55,000 boxes of microfilm to supply the information. . . .



Or Dan Mills, Chief of Vehicle Registration (bottom right), might be asked to supply the inquirer with information on the registration of a particular motor vehicle.



That roll of film on this microfilm camera permanently preserved all the motor vehicle documents stacked behind it. Mrs. Lois Owen inserts documents into the machine to preserve more documents on film.

(5) Issuance of Certificates of Title to motor-vehicle owners from applications received by county tax collectors.

(6) Proper filing of registration and title records and furnishing of information from such records to the public and law enforcement agencies.

(7) Negotiation of reciprocal agreements on motor-vehicle laws with other states and countries.

(8) Administration of the Texas Water Safety Act that applies to registration of motorboats, and

(9) Investigation of various types of illegal registration and transmittal of such information to a law enforcement agency or for filing of charges in court.

R. W. Townsley, who has come up through the ranks of the Texas Highway Department, is director of the Motor Vehicle Division.

Townsley, who has been with the Highway Department since 1941, began that tenure as a Certificate of Title examiner "at $100 a month." Early in 1942, he left the Department to enlist in the Army Air Corps. He served almost four years as first sergeant in the 311th Bombardment Squadron. Twenty-seven of those months of enlistment were in the African and Italian Campaigns.

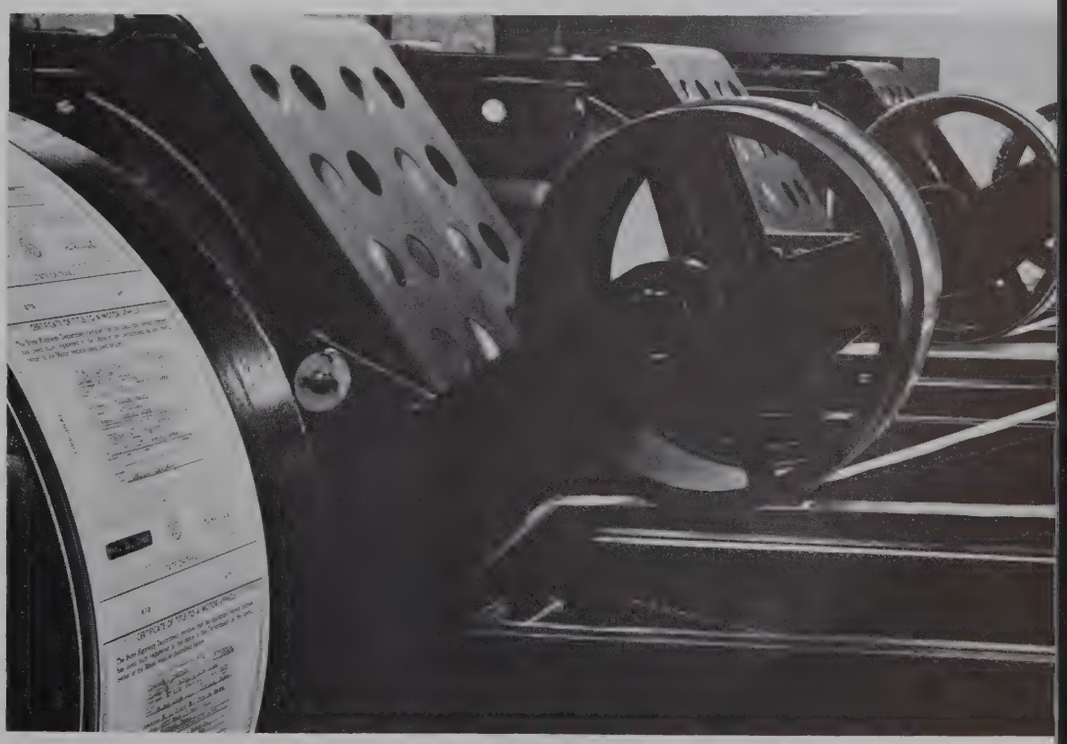
Back at the Department, he continued as a title examiner until November 17, 1958, when he was promoted to succeed the retiring Wray Weddell as Chief of Registration. In August 1960, Townsley became director of Motor Vehicle with the retirement of D. T. Harkrider.

A native of Blanco, Townsley attended Austin Public Schools. He studied engineering and special studies in law while a student at North Texas Agricultural College in Arlington. He and his wife, Alice, have two children—Steve, 14, and Judy, 12.

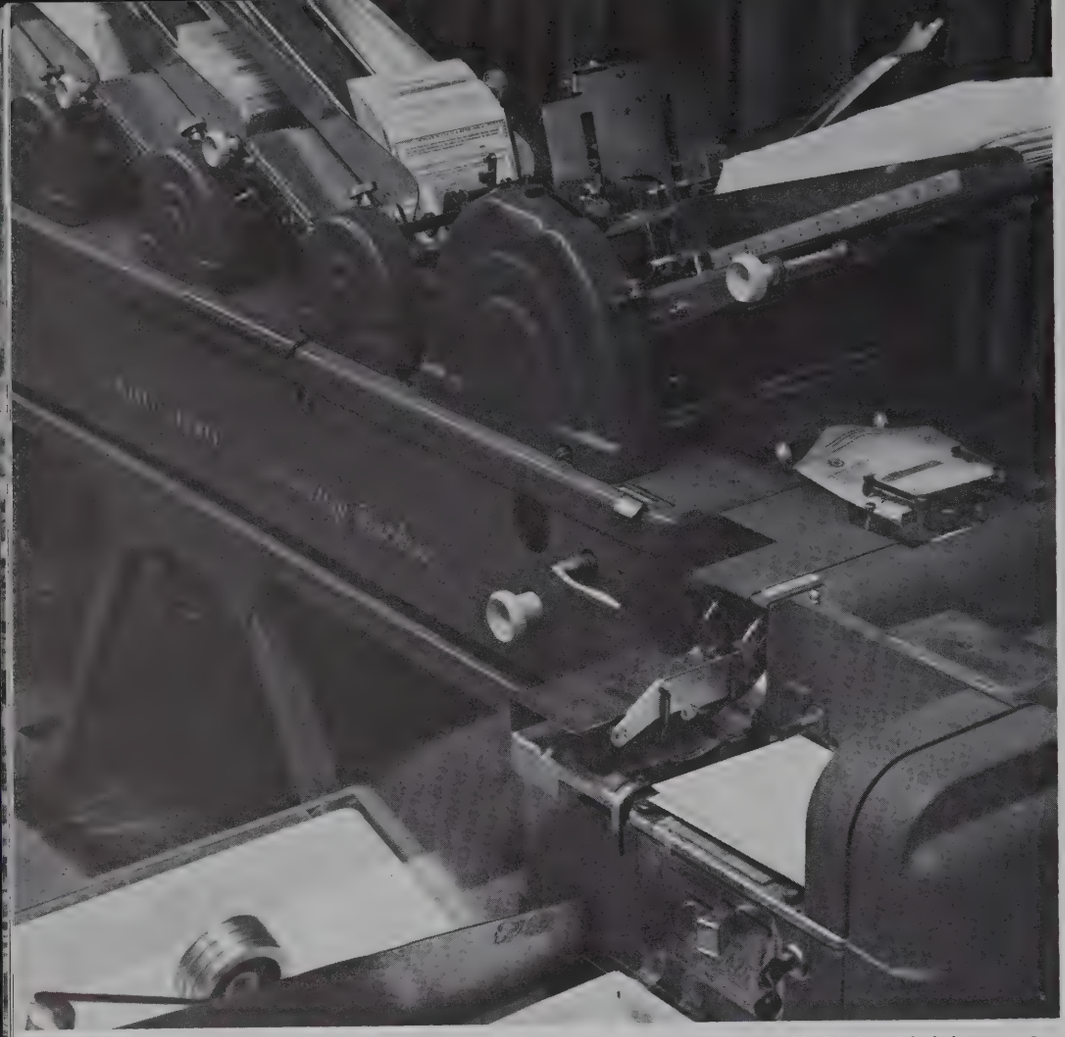
Planning and Research, one of the nine sections in the Motor Vehicle Division, is under Townsley's immediate supervision. This is the section to which other sections in Motor Vehicle direct their questions for the improvement of operations to make for the efficiency that characterizes the division.

Three persons direct the operations of the eight other sections in Motor Vehicle Division. Bart Couch, Chief of Vehicle Titles, supervises the Dexigraph, Title Examining, and Correspondence Sections. The four sections under Dan Mills, Chief of Vehicle Registrations, are File Checking, Accounting, Supply, and License Plate Manufacturing (located at Huntsville). Sam Stewart, Chief Investigator, heads the Investigation Section, and is assisted by D. L. Johnson, chief supervisor.

Certificates of Title to all motor vehicles requiring licenses in Texas are issued by the Title Examining



Thousands of Certificates of Title to a motor vehicle are turned out daily by this Dexigraph machine. During an average eight-hour day, personnel in this section process an average of 12,000 Certificates of Title.



This inserting machine in the mail room of Motor Vehicle Division automatically inserts Certificates of Title into custom-made window-type envelopes at the rate of 100 per minute.

Section. William D. Litton is chief supervisor of the section that falls under Couch's purview.

Couch is a pioneer in the business of issuing Certificates of Title in the Lone Star State. He was with the Department of Public Safety in the late Thirties when DPS was given charge of issuing titles with passage of the Certificate of Title Act on October 1, 1939. When the Texas Highway Department took over issuance of titles on May 3, 1941, Couch was put in charge of the section.

The Texas Highway Department issued Certificate of Title Number 1 on June 30, 1941, to a Fred Powell of Beaumont, Jefferson County, on a 1939 Packard Coupe, License Number 746-163. And just this past February —February 2, 1962, to be exact, Motor Vehicle Division issued Certificate of Title Number 27,000,000 to R. M. Canada of Houston, Harris County, on a 1953 Mercury two-door sedan, License Number RK-1427.

The work of transferring title applications into the Certificate of Title you look for each year to get your new license plates is done in the Dexigraph Section. During an average day, workers in this section process an average of 12,000 Certificates of Title. During registration-renewal time, roughly February through April, this figure may soar to an average daily tabulation of 19,500.

Dexigraph Section, of which Carl F. Noack is chief supervisor, also includes the microfilm laboratory and microfilm library of Motor Vehicle Division. The library consists of 55,451 boxes of 100-foot rolls of microfilm. Each roll of film has an average of 3,100 exposures.

At the last count, it was estimated that the complete microfilm library has permanently preserved 220,677,900 documents. Once these documents—127,422,400 titles and 93,255,500 registration receipts—were put on film, they were destroyed for space purposes.

If all the rolls were spliced together, they would produce a film 1,100 miles long—roughly the distance from Orange, Texas, to Mexico City via Matamoros.

The Correspondence Section may not sing about its "fan" mail as does Perry Como on his television show, but the mail received is considerable. So is the outgoing mail from this Section of which J. B. Smith is chief supervisor.

Smith's employees answer an average of 500 letters a day. And during the registration-renewal period, they deserve a letter themselves—an E for effort—for that figure has been known to double in output.

The four sections under supervision of Mills are stopping places when anyone in Motor Vehicle wants to check up on the registration of a motor vehicle, the quantity of license plates shipped to a particular county, or the total receipts from license plates sales in any of the 254 Texas counties.

Tommy Kouri is chief supervisor of the File Checking Section. This section, which would house a 28-lane bowling alley, contains hundreds of steel file cabinets containing 45,000,000 title and registration records.

The records here are consulted hundreds of times daily by telephone receptionists in the Registration and Title Information Center. Traffic to these files also is heavy to answer general mail inquiries and questions from persons visiting the information counter in the lobby of the Motor Vehicle Division.

Planning—eighteen months in advance—how many license plates must be available to meet the motor vehicle needs of Texas is the task assigned to the Supply Section, of which Bob Doetsch is chief supervisor. Already, this section has ordered 10,700,000 single license plates from the license-plate manufacturing plant at Huntsville State Prison for use during 1963.

(Operations of the License Plate Manufacturing Section, although located at Huntsville, are under supervision of the Austin headquarters. However, B. L. Vann is stationed at Huntsville as chief supervisor of the section.)

Doetsch's section also sees that the county tax collectors throughout the state always have an up-to-date supply of forms and applications to use with the sale of license plates and for filing the applications for titles.

Supply Section also issues exempt license plates (silver with black letters) to all city, county, and state agencies in Texas. In 1960 (later records are not complete), 52,424 such license plates were stamped out by the inmates at Huntsville.

The manufacture of license plates creates many problems because there are now 28 different Texas license plates produced annually. This multiplicity of license plates is the result of laws passed during sessions of the Texas Legislature calling for the creation of these special plates.

At the present time, there are separate license plates issued to members of the United States House and a different set of plates issued to United States Senators. There are also plates for motor vehicles owned and operated by nonprofit and disaster relief organizations and others designed and used primarily for parade purposes. You can also get plates for your antique automobile.

Or, if you hold a Federal Communications Commission mobile amateur radio station license, you can get two amateur radio license plates.

In most instances, the cost of special plates is determined by the weight of the motor vehicle. For instance, they may range from $4.62 for a small foreign sports car to $439.56 for a large truck tractor.

The Accounting Section, of which Bob Brewer is Chief Supervisor, keeps track of all the debits and credits it takes to run the largest division of the Texas Highway Department.

Some of us may conjure up the operations of the Accounting Section as being pretty cut and dried in the manner that Charles Dickens wrote about this business of neatly entered figures in column after column of leather-bound ledgers.

Not so!

Workers in this section have been known to play "The Millionaire" game—except the money they use is real and not the paper money handed out by Michael Anthony on the television show that inspired these seven-digit doings.

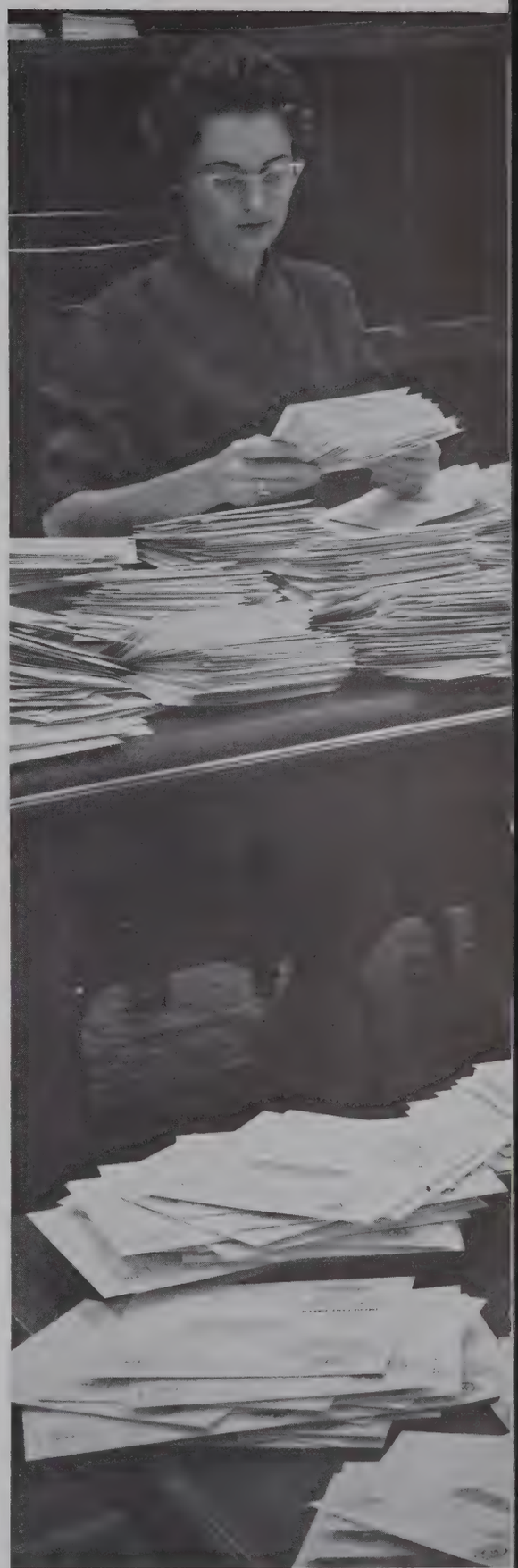
Such large checks usually come from Texas counties of the size of Harris County and Dallas County as revenue from license plates sales.

The Investigation Section's chief task is to see that persons residing in a particular county are driving a motor vehicle with license plates obtained in that county. This section also cooperates with the various 254 Texas county tax collectors in the collection and reporting of registration and title fees.

For its operations, Stewart's section divides Texas into eight districts. Each district is composed of about 30 counties. The investigator assigned to each district sees to it that the law regarding registration within the county is not broken.

Stewart's investigators also are responsible for overseeing reciprocity agreements between Texas and the other states who mutually share their respective highways for interstate transportation without assessment of a license fee. Almost all the 50 states in the Union are in reciprocity agreements with each other, with some of the western states not participants. Drivers of commercial motor vehicles coming from these states not in reciprocity must buy a Texas license before they are permitted to operate their vehicle on a Texas highway.

The recent passage of House Bill 805 gave the Investigation Section an-



Mrs. Polly Sigrest sorts Certificates of Title by destination for quicker delivery by the post office.

Masses of boxes of microfilm envelop Mrs. Charlene Fitzgerald at work in the microfilm library.

other duty. Until this law was passed on August 28, 1961, stolen vehicles were being driven throughout the state with license plates obtained from wrecked automobiles.

This law requires all wrecking yards and other salvage places of motor vehicles in Texas to remove the unexpired license plates of wrecked vehicles that they purchase. Junkyard dealers must turn in the license plates and title to the wrecked vehicle to any one of five other field men assigned to the Investigation Section. These roving investigators dispose of what could be free-riding license plates by cutting them in half.

Today, there are more motor vehicles registered in Texas than there were people in Texas in 1917. That was the year the first Registration Motor Vehicle Act was passed.

Statistics are not available for the 1917 population in Texas, but neither population figures for the decades preceding nor following 1917 equal the 5,000,000 license plates issued in 1961. The population was 3,896,552 in 1910 and 4,663,228 in 1920.

Those first license plates in 1917 were two plates—just as we have today. However, one of them was a circular disc measuring four and three-eighths inches in diameter. The other was a rectangular plate five and one-half inches high and 16 inches long.

Motorists put the disc on the radiator of their vehicle, and the longer plate was affixed to the back of the vehicle.

The disc was fire-engine red and white, and in its middle was a white Lone Star in which a red "1917" was centered. The letters, "TEXAS," also in white, flanked the angles of the star. Along the outer red circle, the words, "Registered Motor Vehicle," were embossed in white.

On the larger plate were embossed white numerals on a black background.

A motor vehicle registered in 1917 cost its owner 35 cents per horsepower. The rate for a commercial vehicle was determined by the pounds of weight on each wheel.

And when a person applied for a license to operate a motor vehicle as a chauffeur in 1917, the Texas Highway Department also furnished him with a metal badge "to be at all times prominently displayed" when operating a motor vehicle on the public highways. Also, before the license was issued, two reputable citizens had to swear that the applicant was "trustworthy, sober and competent . . ."

Registration laws of Texas provide that a certain portion of the registration fees be retained by the county tax collectors as compensation for their efforts in registering these millions of motor vehicles and for expenses in building their county roads.

Any county whose gross fees do not exceed $50,000 in a single year gets to keep all the money. When fees exceed $50,000, but are less than $175,000, the county must divide half of this amount with the state. Counties with more than $175,000 in license-plate sales send all fees above that amount to the Texas Highway Department.

In 1960, fees returned from the county tax collectors on license-plate sales amounted to $105,065,301.35. After the counties received their proper share as explained above (it was $26,948,470.76 in 1960), the State of Texas banked $75,402,558.71 into its General Highway Fund for construction and maintenance of certain highways.

A portion of the state's revenue—$15,000,000—is appropriated by the Texas Legislature each year to the Department of Public Safety. DPS applies this money to its Highway Patrol operations.

To the obvious question, Couch—with a justifiable pride—pointed out that the tremendous increase in the volume of work, without a comparable increase in personnel, had affected the operations of the Division.

But the effect was one of even more efficiency.

"Part of the reason for this continuing efficiency," Couch explained, "is the constant study to improve machine operations and organization techniques.

"But probably the most important reason for this efficiency is that the people in the Motor Vehicle Division are career people. Some of them have been here as many as 40 years."

One employee wandered into Couch's office about the time he made this statement. The employee was working up a report that required Couch's job title. He asked Couch for it.

Couch, who has been with the Motor Vehicle Division more than 20 years, really shook up the employee.

"Guess I haven't been here long enough to remember my title," he joked.

Experience in Texas With Continuously Reinforced Concrete Pavement*

B. F. McCullough, Associate Design Engineer
Highway Design Division

This article divides Texas' experience with continuously reinforced concrete into two divisions: (1) the evolution of the present CPCR(B)-61 detail used by the Texas Highway Department, and (2) pertinent observations made during the inspection of various continuous pavements over the state. No attempt will be made to cover the design procedure of continuous pavement since it has been presented on several other occasions in the past; furthermore, I will make the basic assumption that most of you are acquainted with this pavement type.

EVOLUTION OF CPCR DESIGN

A brief look at the evolution of the present CPCR(B)-61 design detail should prove interesting to everyone—be he a designer or a construction man. During the last five years continuous pavement has been the subject of numerous studies, and we in the Design Division have tried to use the results of these studies to provide a more durable and economical design.

For simplicity of presentation, the design development is broken down into six subheadings.

Steel Percentage and Thickness

This topic has been covered by previous papers, therefore, it should be sufficient to say that the present design consists of an eight-inch pavement with .5 per cent longitudinal steel.

Bond Area—Concrete Volume Ratio

This topic has also been discussed in previous papers, hence it will not be covered in this presentation other than to state that an optimum bond area-concrete volume ratio means that small bars at small spacings were used insofar as possible.

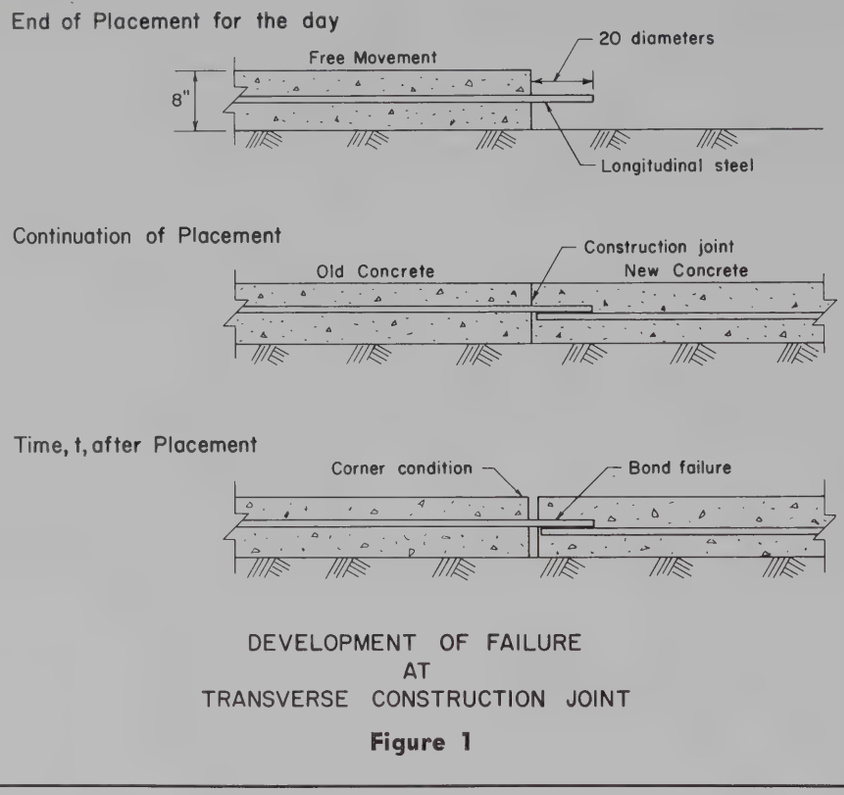
Additional Steel at Transverse Construction Joints

The nomenclature used here simply refers to the insertion of extra bars at transverse construction joints at the end of a day's placement, in addition to the regular longitudinal steel that extends through the header. Unfortunately this change was brought about by a lesson in the school of experience.

On some of the earlier projects, the common practice at the end of a day's placement was simply to protrude sufficient longitudinal steel through the header to provide for a twenty-diameter lap. Figure 1 provides background for the problem created by this antiquated practice. This figure portrays a typical edge view of a slab at a transverse construction joint, with the direction of concrete placement being to the right of the figure. The top panel is the condition for the termination of a day's concrete placement where a header would be installed. A twenty-diameter protrusion of the longitudinal steel through the header is left for tying onto when the placement operations are resumed. The pavement end is free to move due to any volume changes resulting from thermal variations and hydration shrinkage during this period.

The middle panel shows the case where the concrete-placement opera-

*Presented at the 36th Annual Short Course.



DEVELOPMENT OF FAILURE
AT
TRANSVERSE CONSTRUCTION JOINT

Figure 1

tions are continued at some later date. At this time, there is a condition of old concrete to the left attempting to fluctuate, being resisted by the new concrete (to the right) through bond of concrete to the longitudinal steel. From a relative strength standpoint the old concrete to the left is much stronger than the new concrete.

In the bottom panel, the end result at some time, *t*, after placement, is portrayed. The concrete to the right fails in bond as the volume change stresses build up because of insufficient lap. Therefore, the construction joint opens extensively with a resulting loss of load-transfer capabilities. With the excessive opening, a corner loading condition develops in lieu of the continuity condition the design was based on. Hence, the pavement thickness is now inadequate at this location.

The absence of the load transfer across the construction joint results in a failure of the type so vividly portrayed in Figure 2. The pavement initially breaks up in the outside lane where the heaviest traffic passes. The old concrete is to the right of the construction joint, and the new concrete is to the left. The straight lines across the picture are saw cuts made prior to removal and repair. The transverse crack to the left of the construction joint occurred at the end of protruding longitudinal steel where slippage had taken place. This picture points out that very little movement or slippage is required at the joint for an impending failure condition to develop.

Staggered Lap

The term refers to the reduction of the longitudinal bar laps within any transverse plane across the pavement. On several of the earlier projects where lap staggering was not practiced, dual transverse cracks about one foot apart developed at distances equivalent to the length of the reinforcing bars used. A rational analysis of the practice of placing all the bar laps within any one transverse plane inferred that the formation of a crack across the area would develop a stress concentration, and the visual existence of the dual cracks was a signal of the probability that bond slippage had occurred. As of the

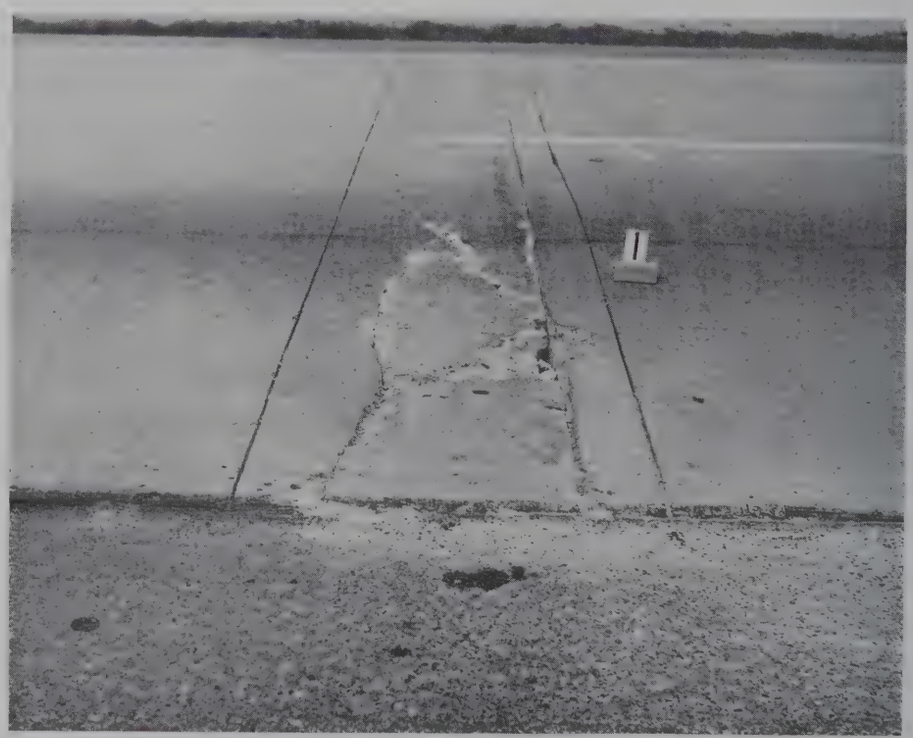


Figure 2

present time, no deterioration has been detected at any of these locations, but the possibility of the development of a condition similar to that experienced at the construction joint exists.

Therefore, the present requirement that specified "not more than 33 per cent of longitudinal bars within any two feet of pavement length shall be lapped" was inserted to remove this possible weak phase of the design. This requirement represented a compromise between a practical and an ideal condition since a full stagger of laps would be the ideal condition from the standpoint of compatibility. Figure 3 portrays a full staggering of laps on a typical project in the state.

Control of Cement Type

A comparison of the stresses obtained in the longitudinal steel with concrete, using Type I cement and Type III cement on one experimental project, manifested the need for prohibiting the use of Type III cement with continuous pavement. The project under consideration had a series of SR-4 strain gauges mounted on the longitudinal steel in two separate installations. In one installation a Type III cement was used in the concrete while the other installation contained concrete with a Type I cement.

Figure 4 gives a graphic portrayal of the effect of cement type on steel stresses during the curing period. The dashed portion of each of the relations is the change in the steel stress

Figure 3

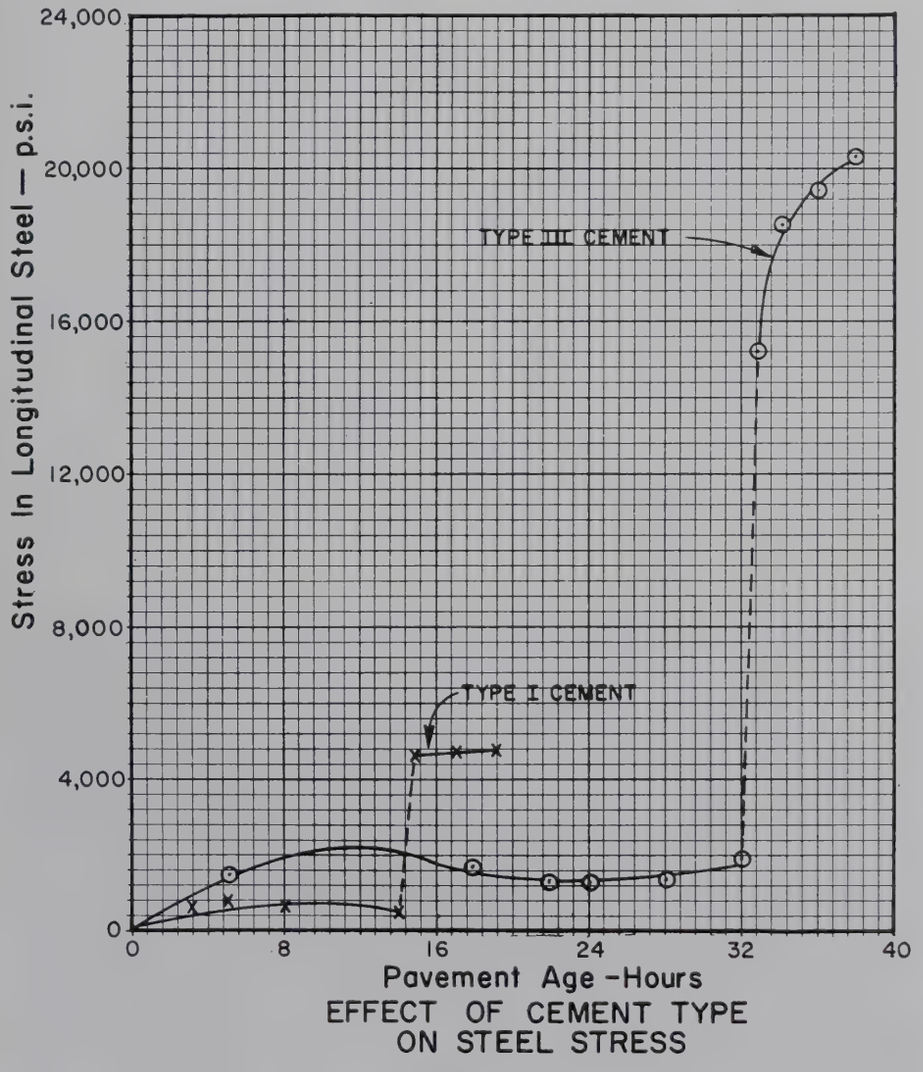
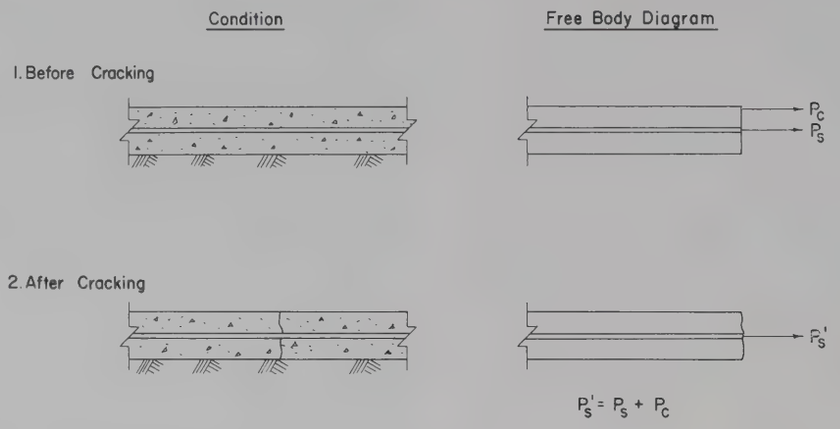


Figure 4

conditions at the time of pavement cracking. Note the change in stress magnitude in both cases. Upon cracking, the stress in the steel goes from approximately 500 psi to 4,500 psi with Type I cement, a diference of 4,000 psi. With the Type III cement, the stress in the steel goes from 2,000 psi to 20,000 psi, a difference of 18,000 psi. The cracking in concrete with a Type III cement is of an explosive nature.

Comparing the two types of cement, it is apparent that the steel stresses with the Type III cement are four to five times as great as the stresses with the Type I. The ratio continues to expand during the initial ten days of pavement life. It is believed that the magnitude of this ratio illustrates the need for eliminating the Type III cement with continuously reinforced concrete pavement. It might be pointed out here that any cement with a fineness value in excess of 2000 cm^2/gm, as measured with the Wagner Turbidimeter Test, should be classified as Type III cement.

As background for an explanation of the extreme differential in stress levels, the following observations should be retained from Figure 4.



STUDY OF FORCE CONDITIONS
BEFORE AND AFTER
CONCRETE CRACKING

Figure 5

First, the failure in Type I occurs at approximately 14 hours, whereas the failure in Type III does not occur until an age of 33 hours—which is in the second 24-hour cycle. For an understanding of the forces involved in a continuous pavement, before and after cracking, examine the free-body diagrams in Figure 5. It is pointed out here that periods of concrete contraction are the ones of major concern with this type of pavement.

On the left side of the picture, the conditions before cracking in the top portion of the picture and after cracking at the bottom are presented. On the right, the free body or force diagram for each of these conditions (neglecting the effect of subbase friction) is shown. Note that in the force diagram for the period prior to cracking, the forces developed in the pavement by volumetric changes are carried by the concrete and the steel. After the crack occurs, the concrete cannot carry tensile forces, therefore the steel must carry the total force developed. Hence, the tensile stress in the steel will always be greater at a crack than in the interior of a slab.

Now with the concept of the steel carrying the total force at a crack (from Figure 4), and the observation from Figure 5 that the concrete cracked at fourteen hours with Type I cement and at thirty-three hours with Type III cement, an explanation of the observed differential stress levels is forthcoming. The basic difference between Type I and Type III cement is that Type III attains its strength much more rapidly than Type I, especially during the first 72 hours.

At the time of fracture, pointed out previously, the Type I cement had attained a strength of only 40 psi and the Type III had attained a strength of 220 psi. This means that approximately 2,500 pounds of force were dropped into each steel bar when the Type I cement was used, whereas up to 11,000 pounds of force were dropped into each bar with the Type III. Hence, the reason for the difference in steel-stress levels for the two cement types after cracking. With these observations in mind, it would suffice to say that with continuous pavement a cement which is characterized by a slow, steady gain in strength (Type I) is desired.

Proper Concrete Vibration

This is another concept that has been acquired through experience. In most cases, preferred construction practices call for the assembly of the steel mats on the subbase. These mats are maintained at the proper elevation by the use of bar chairs. Therefore, with this procedure, the relative position of the steel becomes fixed, and the concrete must flow around and under the bars, rather than the bar mat settling into the concrete as would be the case with the "double strike-off" method. In cases where a harsh mixture was not vibrated properly, the concrete below the steel was found to be honeycombed and of very low density. In essence, with these conditions, no longer is there an eight-inch slab, but rather a four-inch slab with a bar mat beneath it. Unfortunately, this flaw does not show during the period of construction or immediately thereafter, but all designers know that a four-inch slab is not sufficient for the traffic experienced on most of our highways. This fact

Figure 6

Figure 7

becomes evident shortly after traffic is turned on a pavement that has an area of deficient thickness. Figure 6 exhibits a graphic illustration of a failure that developed due to a condition of insufficient vibration of the concrete in the lower portion of the slab. This failure occurred near the centerline of the pavement. The vertical cracks on the picture are longitudinal cracks in the pavement that are located directly over the longitudinal bars. A removal of the concrete in this area revealed the effective depth of the concrete was four inches or less due to honeycombing in the lower four inches. The failure is typical of those resulting from insufficient thickness.

These experiences have pointed out the need for proper vibration of the concrete. We are unable to spell out the exact requirements for proper vibration. At this time investigations in progress should provide the necessary information we are lacking.

OBSERVATIONS

During the past few years, personnel from the Research Section, D-8, have observed numerous continuous pavements and discussed many problems with field personnel over the state. For the purpose of disseminating information, it is felt that a brief discussion of several points will be worth while to all concerned. The observations or methods of performing operations that are described in the remainder of the article should not be construed as firm recommendations, since they are presented purely from the standpoint of exchanging ideas.

Longitudinal Construction Joints

Field personnel have indicated two problems concerning longitudinal construction joints in pavements with three lanes or more: (1) the formation of the longitudinal keyway without honeycombing, and (2) fracturing of bent tie bars as they are straightened after the removal of the forms. In solution to the first problem, one district required the contractor to use additional spud vibrators along the edge of the forms to insure formation of the keyway. The latter problem of fracturing tie bars as they are straightened is solved in another district by requiring the contractor to insert the tie bars into holes in the forms. Figure 7 effectively portrays the method used. Note the tie bars extending through the forms on the left side of the picture. Caution should be used to insure that bars are perpendicular to the forms with this method, or other problems will be created when the forms are removed.

Removal of CPCR

The removal of several short sections of one continuous pavement approximately ten years old due to ramp revision produced several interesting observations. One fact was the tightness of the cracks in the lower portion of the pavement as shown in Figure 8. Note the appearance of the crack on the surface where traffic wear has given a false impression of width. At the edge of the pavement you may observe how fine the crack is. The point of the pencil was placed directly on the crack. It is impossible to detect the crack at edge in the photograph, and difficult to find when on location.

Another interesting point is the condition of the steel removed from the pavement and depicted by Figure 9. Note the condition of the bars, no rust at any point on the steel. The project engineer stated the steel looked the same the day it was removed as the day it was placed (remember the time period is ten years). Numerous bars were examined and not one showed evidence of circular

Figure 8

Figure 9

Figure 10

rusty spots that would be indicative of water going through the cracks—again, pointing to the tightness of the cracks. The yield stress of the steel was found to be in excess of that originally required, which indicates the steel has not been overstressed.

Irregularities

As of the present time, there are two irregularities with continuous pavement that are not fully explainable. One irregularity is the depositing of subbase fines on the shoulder, exemplified by Figure 10. A cursory examination of the photograph might lead to the misconception that this is pumping, which is not exactly the case. The deposits are actually the result of free water flowing from beneath the pavement at the crack between shoulder and pavement. The water is actually flowing and not being ejected as would be the case for pumping.

The present concern is that this condition could lead to a future problem, in that a void could be formed under the pavement or that the absence of fines could result in a loss of subbase strength. This problem has been effectively combated in one area by sealing the crack between the shoulder and the pavement with a road asphalt.

Another problem is the appearance of black stains on the pavement at the transverse cracks, characterized by Figure 11. The photograph is of an extreme example of discoloration, but it serves to illustrate the problem. This is another problem that has not been fully explained. These stains have occurred on pavements placed on sandstone subbase, crushed limestone subbases, cement stabilized subbases, surface treatments, and even on an overlay pavement placed over an old 9-6-9 pavement that has six inches of asphalt concrete overlay. Cores taken at cracks in these areas reveal the fact that the stains are not detrimental to the pavement from a structural standpoint.

Figure 11

CONCLUSION

As a result of observations over the state, the author believes continuously reinforced concrete pavement is an excellent pavement type that can produce an excellent service life, but that it should not be looked on as manna from heaven. A long-lasting pavement that covers up any and all defective design and construction practices will not magically appear on the project. The pavement structure everyone is searching for will come about only after a full understanding of the design principles involved by both designer and the construction man, and by practical application. In this type of pavement, the materials are being utilized to the fullest extent. Numerous points have been discussed during the course of this paper, but three of these should be emphasized again:

1. The prohibiting of Type III cement (or high early strength cement) with continuous pavement. A slow gain in strength is the characteristic desired with this type of pavement.
2. Proper vibration of the concrete even though the term "proper" is ambiguous at the present time due to the lack of a satisfactory definition.
3. The material properties that the design of the pavement structure was based on must be obtained on the project.

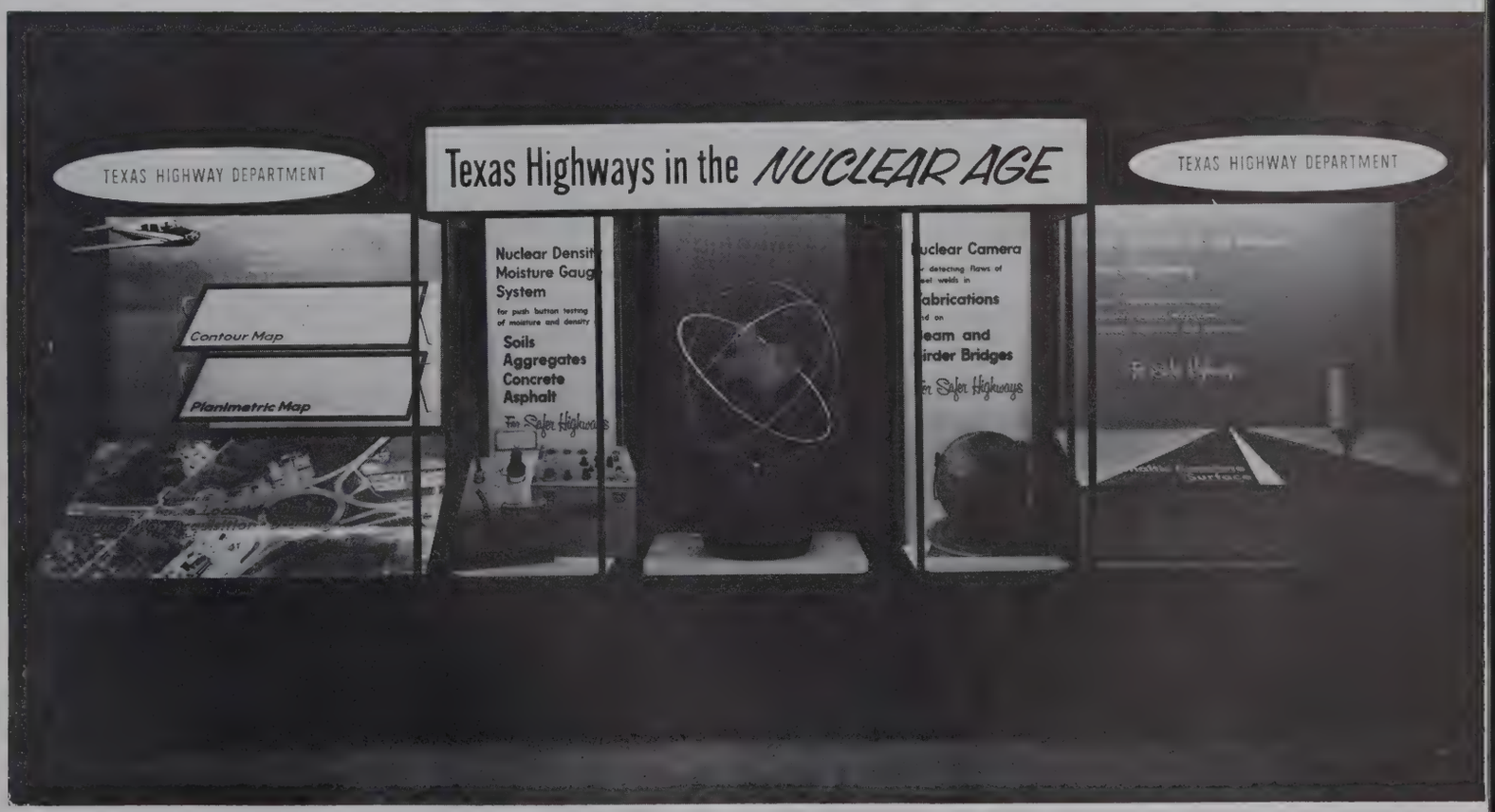
"Texas Highways in the Nuclear Age" was the theme of the Highway Department's public service safety exhibit at the 23rd Annual Texas Safety Association Conference and Governor's Highway Safety Conference held March 25-28 in Dallas.

Two nuclear devices, a density-moisture gauge from District 15 in San Antonio and a nuclear "camera" (projector) from Materials and Tests Division in Austin, were featured as part of the continuing research and development carried on by the Texas Highway Department in building better, safe highways.

The nuclear display was flanked by two other displays of modern highway construction techniques and materials—photogrammetry (See TEXAS HIGHWAYS, February 1962) and

Nuclear Highway Display

A nuclear theme was used in the Highway Department's safety exhibit at the Annual Texas Safety Association Conference and Governor's Highway Safety Conference. The annual event was held in Dallas March 25-28.



Also included in the nuclear age highway theme is photogrammetry—the science of making maps from aerial photographs. This section of the exhibit is five feet wide, two feet deep, and seven and a half feet high.

The nuclear density-moisture gauge system and nuclear projector (neither instrument was available at the time the pictures were made) were brought to Dallas and demonstrated as they would be used on the job site. (See page 3 of this issue for details of the density-moisture gauge.)

Used to check steel welds in fabrication works and beam and girder bridges, the nuclear projector (described in the December 1956 TEX-

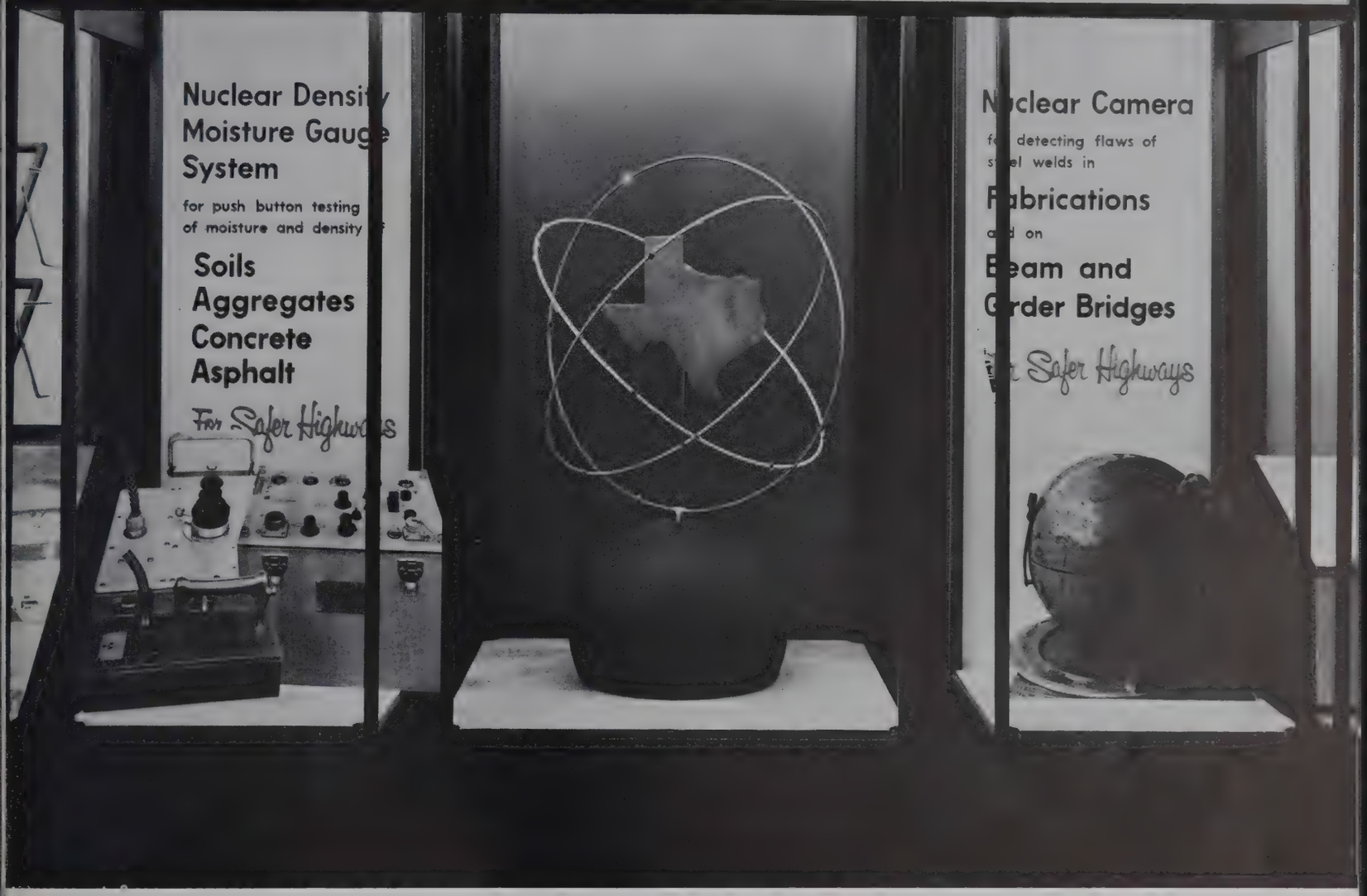
a cross section of the modern Texas highway, showing base materials and surface.

In the center of the exhibit, large steel rings rotate around a gold map of Texas, signifying electron movement of the atom around the nucleus, a universal symbol of atomic energy.

The backdrop for the nuclear instruments is "highway" yellow with black letters describing the instruments. An electric blue panel backs up the simulated atom in the center of the exhibit. A lighter shade of electric blue backs up the other two displays. The words, "For Safer Highways," tells the theme in "GO" green. Translucent plexiglas sheets stretch across the top of the exhibit displaying black letters that identify the theme of the exhibit. All sections are built on one-inch-square steel tubing and lacquered a dark charcoal gray.

Cross section and core show the modern Texas highway flanked by the nuclear display.

Texas Highways in the *NUCLEAR AGE*

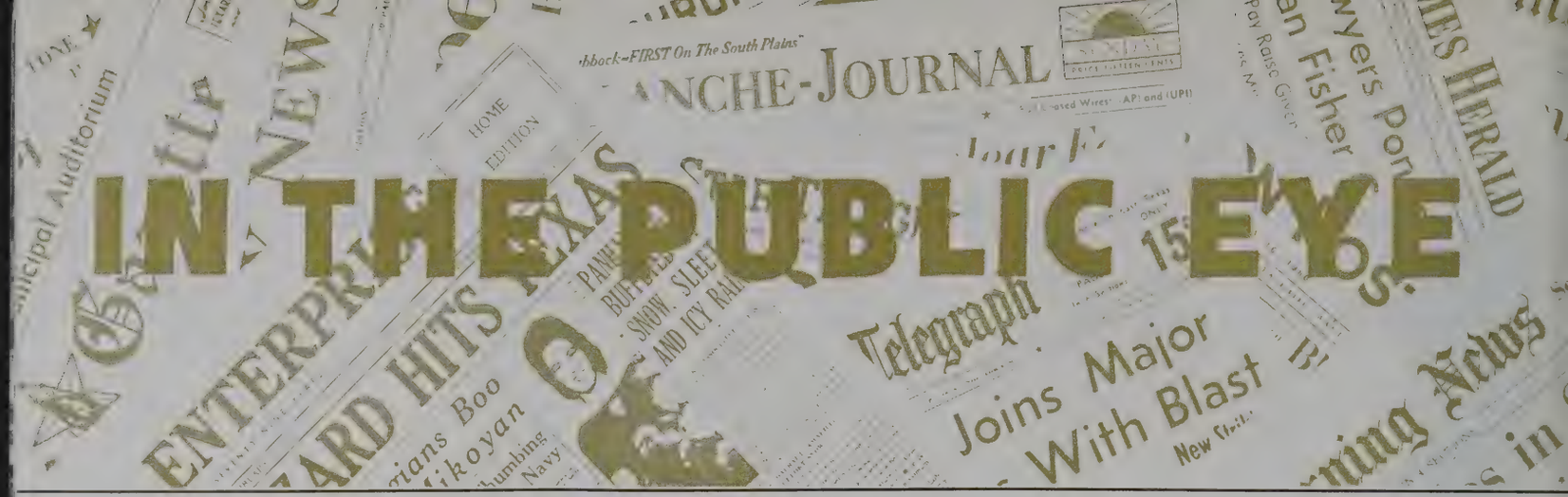


Rotating steel rings around a Texas nucleus signify the universal symbol of atomic energy. Photographs of the nuclear density-moisture gauge and the nuclear "camera" stand in for the actual instruments.

AS HIGHWAYS) had to have its "teeth" pulled for the public appearance. The radioactive source had to be removed for demonstration purposes. Although the radioactive source of Iridium 192 weighs only a few grams and measures one-eighth inch in diameter and length, it packs a terrific wallop. The energy emitted by the small iridium pellet is of such high level that the safe distance in front of the projector, or camera, when it is in use is about 150 feet. But Iridium 192 loses its strength rapidly and decomposes to only half strength in about 74 days.

The principle behind the process is similar to making an X-ray picture, except that gamma rays from a radioisotope are used instead of an X-ray tube. Basically, the projector is a lead ball about five and a half inches in diameter and arranged so that a segment of the sphere can rotate. The energy source is placed in a small opening in the ball and the segment is rotated so the pellet is in the center of the lead ball. This is the "closed" position and the instrument can be handled safely by the operator. In making a picture of the weld, the operator flips a switch which rotates the lead ball electrically, and gamma rays penetrate the steel, registering on a film strip taped to the opposite side of the beam. The resulting picture looks like a doctor's X-ray and reveals any slag, air bubbles, or other defects that may have occurred in the weld.

The safety exhibit was designed by the Travel and Information Division.



THE MOST

Matador Tribune, in reviewing the 1962 Texas Highway Official Travel Map —"It is perhaps one of the most beautiful road maps ever published."

ADVOCATING NEATNESS

Victoria Advocate, announcing that—"The State Highway Department is doing its bit toward helping rural residents keep their mailboxes tidy.

"Persons with rural mailboxes may take them to the highway department maintenance section, on the Hallettsville highway, for painting. However, such services are extended only those having boxes on state-maintained roads.

"At present, there are 1,863 rural boxes in Victoria County."

CAUSE AND EFFECT

Corpus Christi Caller, revealing that the Highway Department has started "a study to determine what effect highway construction has on the value of abutting land. . . . On the basis of land sales made in recent months, chances are that many property owners will be pleasantly surprised at the value of the remainder of their land, according to Harry Coon, right-of-way engineer for the district highway office.

"A report already compiled in Fort Worth shows that the owners of six parcels of land partially taken for an expressway there realized value increases ranging from 9 per cent to 92 per cent."

SUIT DISMISSED

Austin American, via Associated Press —"District Judge Jack Roberts dismissed Monday a suit which originally sought to require oil well servicing companies to register equipment and machinery moved on state highways.

". . . Bob Townsley, chief of the motor vehicle division of the State Highway Department, said the suit was dismissed because of a recent change in a law by last month's special session of the Legislature.

"The Legislature deleted the word 'road' from the law, which gave the oil well servicing companies the right to obtain the $5 exemption [from registering].

"Townsley said that . . . effective April 1, all vehicles except three categories must have a regular license or exemption when using the highways. The categories requiring no license or exemption are farm tractors, farm trailers under 4,000 pounds and implements of husbandry."

FREE FERRY?

Corpus Christi Caller, saying—"The Nueces County Commissioners Court today accepted a petition from Port Aransas citizens asking for toll-free ferry service. . . . The petition requests the court to ask the State Highway Commission to take over operation of the ferry and drop the $1 charge which residents now have to pay."

DOMESTIC OR FOREIGN?

Houston Post, reporting that—"District Judge Herman Jones declared a mistrial Friday night in the Texas Association of Steel Importers' suit against the Texas Highway Commission, . . . when the jury announced it was unable to reach a verdict after nearly nine hours of deliberation.

"The importers brought the suit to test the legality of a 1960 commission order banning use of imported steel in Texas highway construction."

Houston Chronicle, explaining why the order was issued—"The nearness of domestic suppliers, for tests and inspections, is the main reason the State Highway Commission banned foreign products from Texas road materials . . . said . . . assistant state highway engineer J. C. Dingwall. . . ."

THE END'S IN SIGHT

Marshall News-Messenger, pointing out that—"The appraising of right of way for the Interstate 20 project through Harrison County is nearing completion, according to Tom Rideout, senior resident engineer with the Texas Highway Department.

"Completion of the right of way appraisals means that the Texas Highway Department can continue purchasing the land for the four-lane divided highway which will eventually be a through route across the southern part of the United States."

THREE TO ONE

Corpus Christi Caller, noting—"The first construction in the Coastal Bend on a 460-mile expressway that eventually will link Houston and Brownsville will get started in the near future.

"Although the coastal expressway will not pass directly through Corpus Christi, it will intersect Interstate 37, now in the early stages of construction at Calallen. Thus, expressways from the Rio Grande Valley, San Antonio and Houston will lead into Corpus Christi."

MIDSUMMER GOAL

Denton Record-Chronicle, in a special from McKinney—"If all goes well, trav-

elers between Fort Worth and points in Northeast Texas can make the trip via McKinney and State Highway 121 by midsummer, said John R. Taylor Jr., resident engineer for the Texas Highway Department here.

". . . Once finished, travelers will be able to drive from Fort Worth, through McKinney and on to Bonham over a new road that will cut travel time considerably.

"Completion of 121 will give Collin County still another highway to be added to an already excellent system of roads."

THE BIG STORY

Waco Tribune-Herald, featuring Departmental construction there—"Years of research, planning and preparation and a wide array of engineering talents go into the roads, freeways, and bridges built by the Texas Highway Department.

"The story of what takes place before a brand new highway is opened to traffic is long and detailed. . . ."

TRAVELERS' BOON

Port Neches Chronicle, editorially praising Texas' roadside parks—"No other state is so well blessed with these wonderful facilities to make your traveling more enjoyable.

"These parks are a mighty welcome sight when you need that restful nap, or that thirst quenching drink of water, or that delicious picnic lunch or dinner.

"It's often said that there's more to see in Texas! Thanks to Texas highways and roadside parks you can also see it better."

Childress Reporter, lauding the Department—"Without exception motorists compliment Texas roads. Practically everyone who leaves the state and returns says they were glad to get back on Texas highways. This has been accomplished in what was for a long time the largest state in the Union with the most miles of road to build and maintain. . . . All Texans are proud of the record of the Highway Department."

Dallas Morning News, under Dick West's byline—"Our broad, comfortable highways are the envy of the out-of-staters forced to twist through Tennessee and curve around Kentucky.

"The Texas road network is more remarkable, when it is considered that space is a financial problem. Modern expressway-type highways cost a million dollars a mile—and there is many a mile between Amarillo and Brownsville.

"It has always amazed us how these major highways, and the thousands of miles of lateral and less-important roads, are kept in usable shape."

A DEFINITE ROLE

Longview News, observing—"The mercury vapor lamp installations on Marshall Avenue and Highway 149 have drawn such favorable comment that the city felt Highway 26 entrance to the city should receive the same treatment.

"City Manager Harry Mosley said that the brilliantly-lighted highways play a definite role in lowering the accident rate on the roadways and are a deterrent to crime."

BY ANY OTHER NAME

Port Arthur News, on 16th street being called Gulfway Drive—"The merchants and restaurant people and auto dealers and others agree that '16th' is an old and respected designation.

"But they say a name with more glamor will draw much traffic, which could mean more patronage. The appellation they chose was Gulfway drive.

"A complication is that Groves, which has jurisdiction over the northern half of the street for about a mile, will not go along with the renaming, it seems. So going toward Orange, drivers may be on one street and coming back on another.

"The street is a sector of a state highway [87]. . . ."

BIG BUSINESS

Semi-Weekly Light (Corsicana), covering District Engineer B. L. DeBerry's talk before the Lions Club—"DeBerry's short, fact-filled discourse emphasized again the fact that highway planning and construction in Navarro county, or any county, is big business.

"'We in the highway department have one goal in mind, always—to try to expend our funds in this area to serve the traffic, first, in the most economical way we can. . . . We pledge to work with local government and local groups any way we can.'"

SPACE-AGE PROJECTS

LaPorte Liberal, relating that—"Work is expected to begin as soon as possible on highway projects designed to provide maximum access to the NASA Manned Spacecraft Center at Clear Lake.

"The Texas Highway Commission has authorized the expenditure of $1.9 million on three projects which will serve the huge installation.

"A major portion . . . $1.6 million will be spent on 4.1 miles from State Highway 3 to the main vehicular entrance of the NASA plant. Another $734,000 will be spent for 3.5 miles of roadway from the plant to State Highway 146.

"The third project involves widening of three-tenths of a mile from Interstate Highway 45 to Texas avenue in Webster . . . cost about $60,000."

EXPRESSWAY INFLUENCE

Corpus Christi Times, editorially—"U.S. Interstate 37 to the west and the cross town expressway to the south . . . may be expected to spread urban growth into the rural areas readily accessible to the new high-volume, fast-travel routes.

"Expressways do more than change the face of a city; they powerfully influence its future."

ON SIGNS AND SIGNALS

Wichita Falls Times, declaring—"Among the 1962 road programs which may not get the attention they deserve is the plan of the Bureau of Public Roads for conferences in key cities to promote the adoption of uniform safety aids in the form of signs and signals.

"The new interstate highways, with their big and legible signs and traffic control devices, are providing the traveling public with an idea of what uniformity can mean to pleasurable driving."

CHLOE and the smoothness test

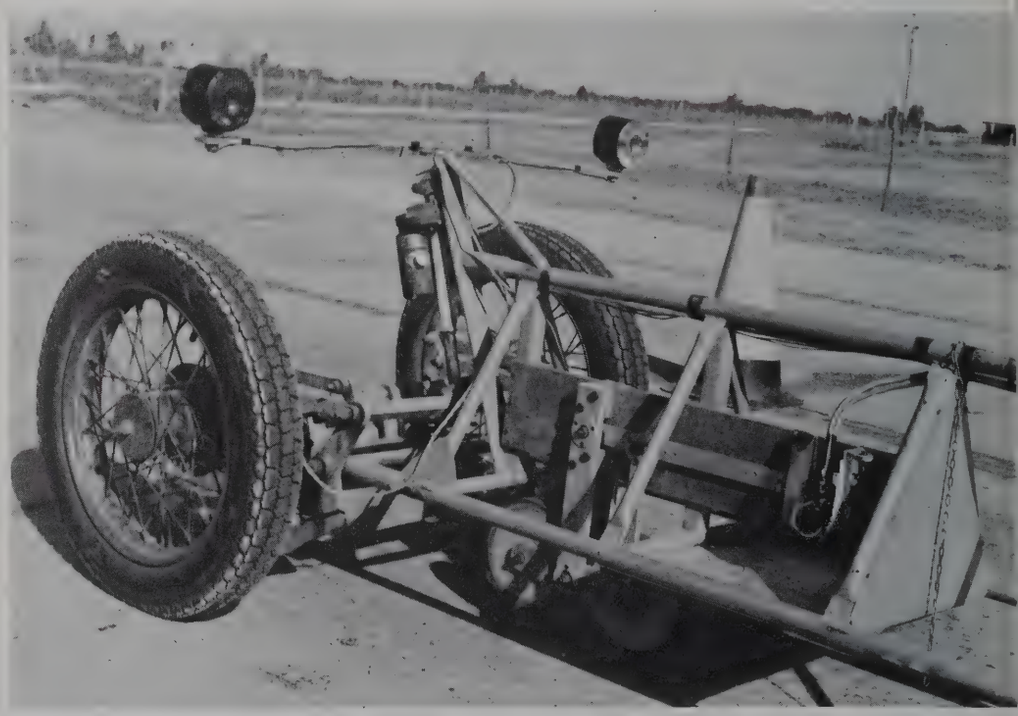
A special survey team, using a new profilometer developed at the AASHO Road Test, recently completed a survey of the riding qualities of nine Texas highways. The team included men from the Texas Highway Department and the Bureau of Public Roads.

In the survey, riding qualities are expressed by a new rating system, also developed at the AASHO Road Test in Illinois. The rating, known as the "present serviceability index," is a mathematical number which is indicative of the riding qualities of pavements. This index is the one which is used in the new AASHO design guides for rigid and flexible pavements.

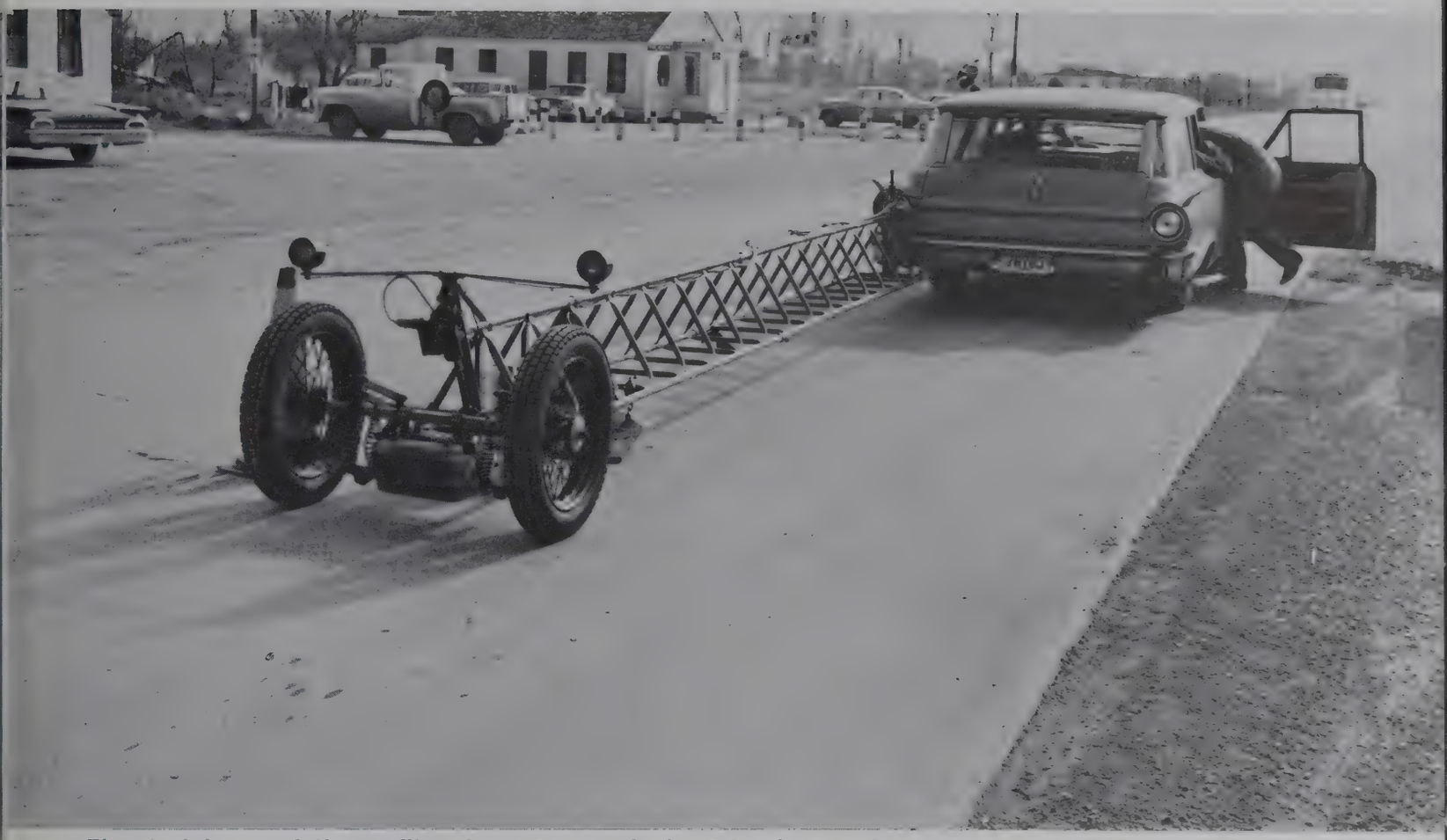
The study made in Texas is part of a national study underway by AASHO. Roads were selected which will be improved, overlayed, or replaced this year. These sections were chosen at random and included both primary and secondary roads. All sections were in the eastern half of the state and ranged from Decatur in North Texas to Alvin near Houston and up to Lufkin and Nacogdoches.

The possible serviceability-index (S.I.) ratings range from zero to five. Five is perfect and zero indicates very poor riding qualities. Normally, new pavements score about 4.5. The serviceability-index ratings made on the nine Texas highways varied from 0.6 to 3.3. Although this range appears to be quite wide, engineers pointed out that the variations were justified because of other considerations, such as improvements required in the geometric design of the roads.

Measurements used to calculate the serviceability index include the profilometer measurement for roughness, cracking and patching of the surface, and rut depth in asphaltic or faulting in portland cement concrete pave-



This new profilometer, developed at the AASHO Road Test, measures the smoothness of highway surfaces. The tandem wheels under the frame are connected by mechanical linkage to the electric pick-off switch in the right-hand corner. A change in the slope of the wheels is measured electrically by the switch and relayed to a computer in the tow car.



The steel frame of the profilometer acts as a horizontal reference for measuring changes in slope of the highway surface.

Keith Severson, BPR technician, reads the battery-powered computer that indicates roughness of the pavement being tested.

Engineer John Huff, BPR (left), and Severson measure faulting of concrete pavement. This is one of three measurements used to calculate the "present serviceability index."

ments. These three measurements are combined mathematically to produce the S.I. rating.

Sections tested ranged from four to ten miles in length. Within each section several subsections 500 feet long were selected at random for measurement.

The new profilometer, CHLOE, derives its name from the men who developed it—Carey, Huckins, Leathers, and Other Engineers. In measuring the pavement profile, this instrument was towed at five miles per hour by a Department station wagon. The frame connecting the profilometer with the tow car acts as a horizontal reference with which to compare the profile of the road. Motorcycle wheels carry the load of the frame and the measuring instruments.

The principle behind the new instrument is simple. Two small wheels called slope wheels are mounted in tandem so they touch the road surface in the wheel path of the car. Steel bars connect the slope wheels to an electric pick-off switch. Any change in the slope between the wheels and the reference frame causes the switch to register the change electrically. This information is fed into a battery-powered computer mounted in the towing car. The computer calculates a mathematical function of the road profile.

By combining mathematically the profile measurements with cracking and patching information, rut depth or faulting, the engineers determine the serviceability index.

Earlier attempts to measure the roughness of new and old highways have generally proved unsatisfactory. The new S.I. rating promises to give highway engineers a more accurate, reliable way to classify highway surfaces.

OVER THE HIGHWAYS

Comments . . . from the Traveling Public

• Driving through Texas from Pennsylvania to Mexico, we encountered bad weather and icy roads, and skidded off the highway into a mud embankment a few miles south of Palestine.

My purpose in writing you is to most highly commend your Highway Department and the chief of the Department at Palestine for the magnificent help they accorded us, towing our car back on to the road and changing a tire (I'm too old to undertake it myself), which was our only damage, and refusal to accept any remuneration for their courteous help.

It is heartening, indeed, to find such hospitality, and my wife and I are most grateful.

Raymond Brunswick
Institute of Allende
San Miguel de Allende, Mexico

Habla vds. Espanol?

• How are you doing I hope your famidly (sic) are doing find (sic). How is Texas have a rodeo How mary (sic) of cowboy got buck off a horse but if you send me a letter back to me ill (sic) be send someone else a letter so Hideo semego (sic)—if you leand (sic) to teasch (sic) me how to say Hideo semego (sic).

Yours truly
Hiram Newman Jones

◈ *Ed. Note—We figure he means adios amigos. Spelling is bad when you learn on television.*

• One of your employees, Mr. A. P. Browning of Archer City, returned to our office one of our Smith Oil Agitators which he had found on the highway near Archer City.

We want to commend him for such an honest act, and appreciate his returning this to us. This bespeaks well for all the employees of the Highway Department.

T. C. Anthony
Wichita Falls, Texas

◈ *A news article carried state wide on there being a roadside park for each 72 miles of Texas roads brought comment pro and con in letters to the Department.*

Con

"This is good.

"However, nine out of ten parks you will find a truck driver asleep on the table. This makes them unusable except on Sunday, and a very expensive park for truck drivers to sleep."

W. D. Smith
Fort Worth, Texas

Pro

"This clipping thrills me for I had no idea Texas had 831 roadside parks. I hasten this note of congratulations to you for the great service you are rendering Texas. . . ."

Lillian Collier
Mumford, Texas

• I would like to take this time to thank you for taking care of the drainage ditch in front of my place on Farm Road 747 near Jacksonville.

Would you please give me the name and address of the man in charge of that district so I can thank him also. He was very nice to my mother in law and did a real good job on this ditch.

Alfred Halick
Houston, Texas

◈ *George T. McCown, Maintenance Construction Foreman at Jacksonville, supervised the Maintenance Section which performed this work.*

• You may say it is none of my business or that I'm a crank or a crackpot but safety is everybody's business.

I am writing to you about one thing you have a lot of trouble about here in Texas.

I arrived here from Japan recently and they have an added safety feature on their signal traffic lights that has paid off in reducing accidents. Before the light turns yellow the green starts blinking and blinks about five to ten times. In that way a motorist knows the light is about ready to change and is able to stop with no trouble at all before the light shows yellow. It is also easier on the nerves because there is no worry about ever running a light unless it is intentional.

Again I say, you may think its none of my business but my intention is only in trying to be helpful in preventing accidents.

Burl Zickefoose
Bergstrom AFB, Texas

To and From Our Readers

The "Case of the Pakistani Postcard" created a furor in Travel and Information Division when it was received. The "wel-knowd" camel driver who visited America—and Texas—at the invitation of Vice President Lyndon Johnson was written up in the papers as Bashir Ahmed. The card requesting a 1962 Highway Travel Map gives the name Bashir Ahmed Sarban. Did the papers just fail to pick up Bashir's entire name, or is this another wel-knowd camel cart driver?

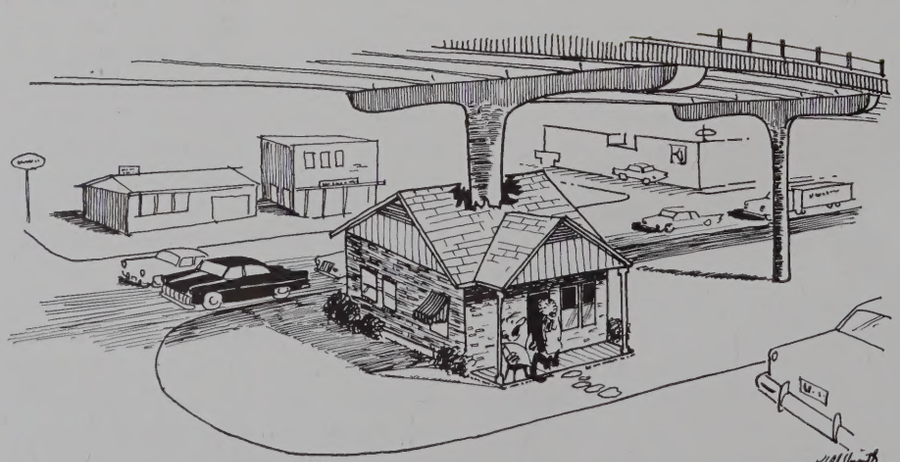
1962 TRAVEL MAP

Mail this card with your name and address to the Texas Highway Department for your complimentary copy of the 1962 Official Highway Travel Map.

Name BASHIR AHMED SARBAN. (WEL-KNOWD CAMEL CART- DRIVER).
(Please Print Plainly)

Address 27, CORNER CHAMBERS. 181, McLEOD ROAD.

City KARACHI. Postal Zone G.P.O. State PAKISTAN.
(Please Do Not Abbreviate or Write Outside the Border)



"I GUESS WE SHOWED THEM WHO WAS GOING TO MOVE AND WHO WASN'T!"

About Our Pictures . . .

Motorists zooming along four-lane divided highways may not have the time to admire the landscape that they had in the past, but the color of springtime wildflowers along Texas highways can be enjoyed at any speed. This month's cover picture is U. S. 59 between Lufkin and Nacogdoches.

Inside the front cover, the skyline of Fort Worth provides fitting background for the stylized urban interchange on Interstate 35, west of the city.

Inside the back cover are Mr. and Mrs. Arthur C. Volz, of Laredo. Volz, Resident Engineer, and his wife were chosen to reign over the sixty-fifth annual Washington's Birthday Celebration as Martha and George Washington.

TEXAS HIGHWAY COMMISSION

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Texas Highways

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